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THE CRANBERRY

CRANBERRY CULTURE

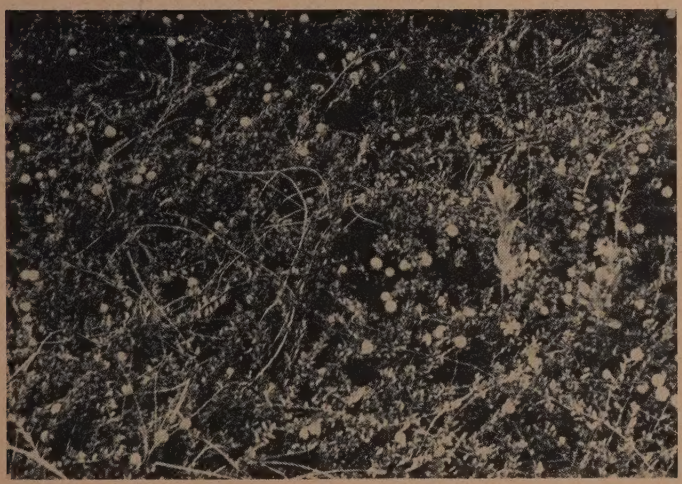
By E. L. Eaton

CRANBERRY DISEASES

By K. A. Harrison

CRANBERRY INSECTS

By C. W. Maxwell and A. D. Pickett



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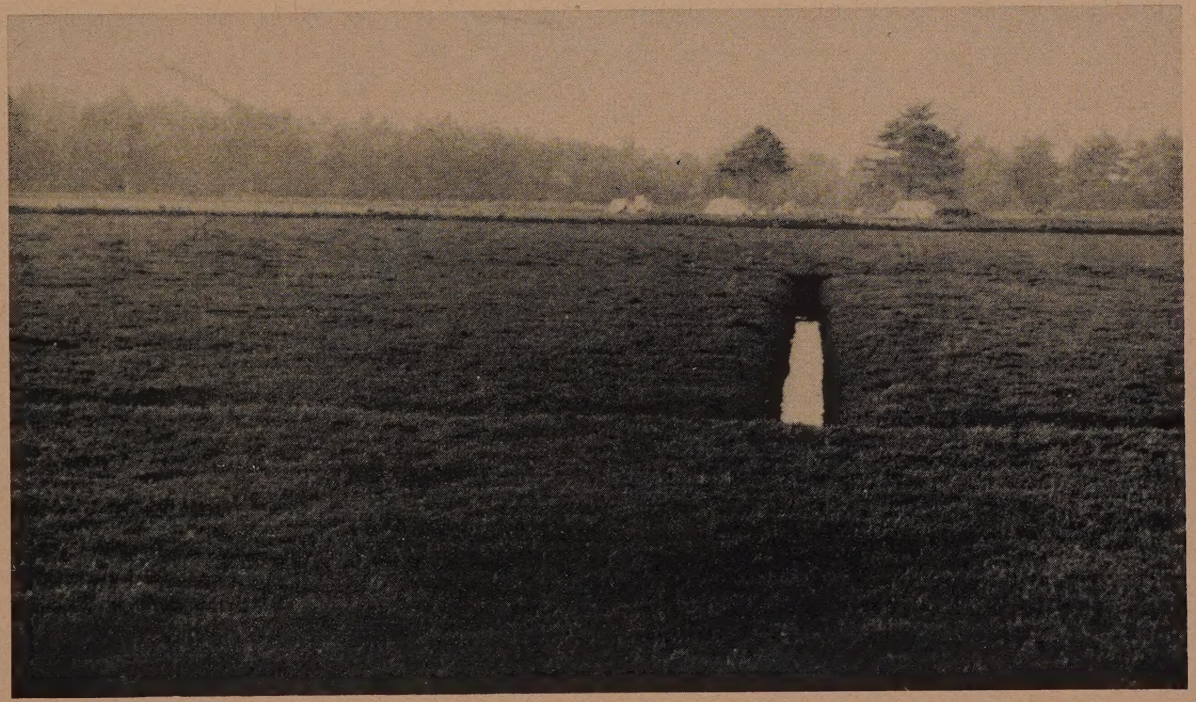

Figure. 1.—A well kept bog showing arrangement of ditches. Note how free the ditches are of weeds.

CRANBERRY CULTURE

E. L. EATON[1]

The cranberry is widely distributed in nature throughout the North Temperate and Sub-Arctic zones of America, Europe and Asia, where the fruit forms an important item of human diet. The culture of cranberries, although a minor industry in Canada, provides the consuming public with a beautiful, tasty, and vitamin-rich fruit, widely acclaimed as a relish with fowl or meat on festive occasions. The fruit is also popular for salads, pies, tarts, jelly or preserves, either alone or blended with fruits of less distinctive flavor such as apples, pears, or peaches.

Botanical Classification

The cranberry belongs to the *Ericaceae* or Heath Family, which includes a large number of cool climate trees and shrubs, among them such well-known native fruits as the huckleberries and blueberries. Three common species of cranberries are listed by Gray[2] as follows:

Vaccinium Vitis-Idaea L. var. *minus* Lodd., is perhaps the most widely distributed. It is known by such local names as partridge berry, foxberry, rock cranberry, mountain cranberry, cowberry, lingenberry and upland cranberry. It is abundant in the more exposed coastal and northern regions and is found on moss-covered rocks and in old pastures. The fruit is smaller, softer and ripens earlier than either of the other species, is highly colored, and in favorable places grows with a profusion that literally carpets the ground with crimson. It possesses a distinctive, spicy, aromatic flavor which places it in a class by itself. There is no record of its having been cultivated successfully but it merits study for those regions where it is adapted.

Vaccinium Oxycoccus L., sometimes called the small cranberry, spiceberry or buckberry, has many fine but vigorous runners. The fruit is mottled gray in color, turning red as it becomes fully ripe. The fruit is seldom abundant, but has a delicate flavor.

Vaccinium macrocarpon Ait. is the large or American cranberry of commerce. The vigorous vines root readily where they touch the damp earth and the many cultivated varieties are easily and rapidly propagated.

The so-called highbush cranberry or pembina, *Viburnum trilobum* Marsh., a coarse shrub or small tree, is found from the Atlantic to British Columbia. The fruit is somewhat like the cranberry in appearance and flavor, but has no other claim to the name. It is closely related to the ornamental snowball *V. opulus* L. which it resembles in foliage and habit of growth. The fruit is used for jelly but the single large seed is objectionable in jam.

Commercial Production

The oldest and most extensive cultivated cranberry bogs in Canada are located in Nova Scotia. A recent survey lists some 230 acres, with over half of this in Kings County. Somewhat smaller acreages are reported in Ontario,

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1 Senior Horticulturist, Native Fruits, Kentville, Nova Scotia.
2 Gray's Manual of Botany, 8th Edition, 1950.

Quebec, New Brunswick and Prince Edward Island. Plantings are being made at an accelerated rate in British Columbia. Accurate records of all yields are not available but individual growers have reported crops in excess of one hundred barrels or five tons per acre from the best bogs. The average is perhaps less than half this.

Many cranberries are imported each year into Canada and two canning factories, one in Quebec, one in British Columbia, process berries of United States origin for sale on the Canadian market. Massachusetts, New Jersey and Wisconsin are the largest producers of cranberries in the United States with a smaller but substantial volume grown in the Pacific Northwest.

Soil Requirements

Wild cranberries of the species grown under cultivation are found along streams, swamps, lakes and sea shores, where the soil is naturally damp or where the temperature is low and evaporation is slow. They are relatively tolerant of water and thrive on soils that are too acid for legumes or other lime-loving plants. Its creeping habit enables the cranberry to occupy low spots in meadows, or high spots in otherwise saturated bogs. A regular and generous moisture supply is essential throughout the summer but too high a water level encourages rushes, sedges and other competing plants to flourish which crowd the cranberries and interfere with pest control and picking.

Figure 2.—Profile of good cranberry bog. The 4" label shows the layer of sand above the black muck.

The moisture-holding capacity of muck soils makes them particularly suitable. A few inches of muck or peat will suffice and many good bogs are underlain with clay, hardpan or sand. Bogs are sometimes built on sand or clay with little or no muck, but these may require more fertilizer to furnish the plant food otherwise supplied by the decaying organic matter.

Sphagnum bogs are undesirable, until they are drained and decay has reduced this bulky material to muck. Neutral or alkaline bogs are not suitable and a pH value of 4.0 to 5.5 is favored.

Wild cranberries are gathered in generous quantities throughout their native region. Many of these areas can be improved by cutting or pulling

Figure 3.—A good bog set-up. Left, reservoir; right, the bog itself; center, main dam; foreground, concrete sluice.

the weeds and brush, by light applications of sand and by timely dusts or sprays for the control of pests. The fruit is often smaller and more uneven in ripening than from bogs planted to one variety.

Cranberries have been successfully planted on relatively dry soils, near the sea, where low summer temperatures retard evaporation. Development costs are low, as the plowing, turfing or sanding can all be done more easily than on a bog. Vines are slower becoming established and yields are usually lower than on conventional bogs where fertility and moisture are more generous.

Drainage

Few plants develop an adequate root system on water-logged soils and the cranberry is no exception. The bog should be laid out so that excess water can be carried away rapidly in the spring or after heavy rains, and the outlet should be large enough to discharge any possible flowage without delay and with a minimum of washing of the ditch banks. Ditches through the bog need to be close enough and deep enough to lower the water-table a foot or more from the surface. This will usually mean ditches two or three feet deep. It should be remembered that drainage will cause a natural decay and subsequent settling of the soil and hence the permanent culverts and spillways should be set considerably deeper than may appear necessary at first, in order to provide for future cleaning and deepening of the ditches.

Sand

A convenient source of clean, sharp sand or fine gravel is needed. The usual three-inch layer on top of the muck when the bog is first built requires 400 cubic yards per acre, and the occasional light re-sanding of one-half inch requires 65 to 70 cubic yards. Distance and ease of loading are thus important in terms of cost. Sand suppresses weeds, is a favorable rooting medium for the cranberry and holds absorbed heat from the sun which is useful in protect-

ing from mild frosts. A simple test of the suitability of the sand can be made by dropping a handful into clear, still water. If the water becomes muddy the presence of loam or clay is indicated. Clean sand will sink without a trace. Loam, clay or silt in the sand encourages weed growth.

Water Supply

A bog with an unlimited water supply offers the best insurance against frost, drought and many insects. If the reservoir is higher than the bog a system of sluices will permit flooding at any time. If the reservoir is lower than the bog, low-lift pumps are available at moderate cost, which can raise the water rapidly. The capacity of pumps is discussed in another paragraph.

Many bogs are now being equipped with sprinklers. These are usually more costly than flooding but can be operated from a smaller reservoir. They will afford protection against frost immediately they are turned on, and picking can be resumed more quickly after sprinkling than after flooding. It is also possible to apply fertilizer or insecticides through a sprinkler system.

Preparation of Bog Land

The first step in preparing a cranberry bog is to ditch or drain the area. If in doubt as to the proper outlet, it may be necessary to employ a drainage engineer. On small areas a reasonably accurate job may be done with an ordinary carpenter's level clamped to a ten-foot straight-edged board. A ditch around the outside, opening into the main outlet, permits the escape of accumulated water or that which may run off from the higher ground. The material from this ditch is thrown to the outside where it forms a part of the dyke to hold winter flood water. Any needed lateral ditches are then opened. These will serve the double purpose of carrying off the excess water and distributing water when the bog is flooded.

The construction of a drainage system is followed by the removal of any trees, stumps or other trash, all of which may be piled and burned at a time when there is no general fire hazard.

Figure 4.—Border ditch with levelled and sanded bog ready for planting at left.

Figure 5.—Main ditch with dam gate and partly constructed dyke in background.

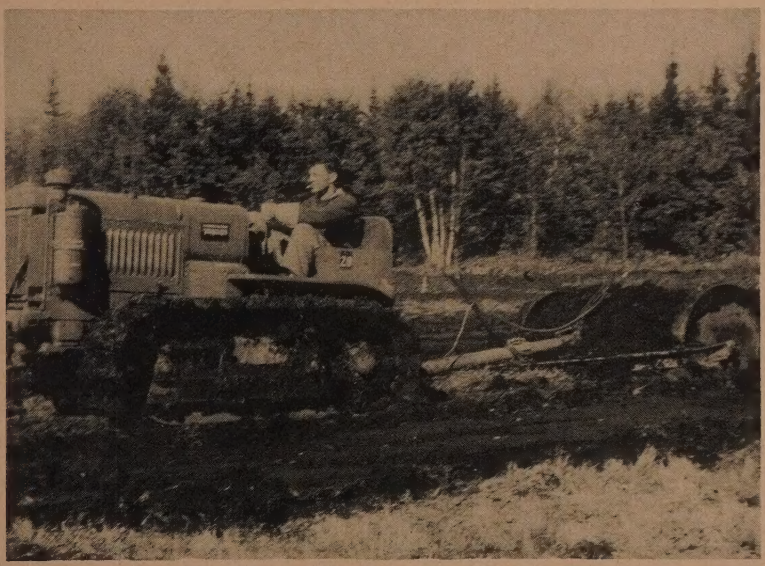

Figure 6.—Levelling bog with roller scraper.

In most of the older bogs the top sod was completely removed. This is a time consuming operation, even where power equipment is available. As a substitute for sod removal the use of chemical weed killers is gaining in popularity. Ammonium sulphamate (sold under the trade name of Ammate)

dissolved in water at the rate of 75 pounds to 100 gallons of water and sprayed or sprinkled at 200 to 400 gallons per acre will kill most growing plants. The land can then be levelled and any poisonous effects from the chemical will have disappeared after one winter.

In addition to the border dyke, cross dykes are often desirable on large bogs to permit flooding in sections. If these dykes are made wide enough they will serve as access roads to the bog. Where the bog is on a slope so that it is too costly to level the entire bottom, it may be cheaper to dyke in sections and flood at different levels. Where different varieties are being grown, each can be planted within one dyked section.

When a dyke or dam is being built a trench or key is first cut to form a ditch directly under where the dyke is to be located. All turf, stumps, and muck are removed from the entire site of the base down to the sand, clay or subsoil, to prevent the escape of water. The turf may be used to face the dyke but the center core should be built of close-binding material which will not decay and collapse. A dyke that is wider at the base than on top, and sloping on both sides, will be stronger and less subject to erosion than one with a steep face. Prior to completion of the dyke the flumes or spillways are built. These will later allow the water to enter or leave the bog. Concrete or chemically treated wood is recommended since untreated wood has a short life under the conditions prevailing in a cranberry bog.

Many different systems have been devised for applying sand. On some of the older bogs, where the sand pit is near, a few planks have provided a track on which to carry the sand in wheelbarrows. In other instances wooden mats, ten or twelve feet long and six or eight feet wide, have been used and the sand carried by wagons or trucks. Hauling by dump truck and spreading on the ice of the flooded bog in winter is perhaps the cheapest way. Where ice is lacking or weak it may be necessary to dump the sand at the edge of the bog and move it by wheelbarrow to the final destination on the bog. The sand may be spread and levelled by shovels and rakes. If the sand pit contains stones, these may be removed by screening, or the person spreading the sand may use them to fill low spots in the bog. If left on the bog, large stones are unpleasant for the pickers and may later find their way into the containers with the berries at harvest time.

Cranberry vines root freely when in contact with damp soil and this habit is exploited in making new plantings. Only vigorous, healthy bogs should be used as a source of planting material. Cuttings can be obtained by mowing the vines with a scythe. There will be less injury to the vines if this is done before new growth starts in the spring. If it is not possible to set these cuttings at once, they can be spread out in a thin layer, sprinkled, and covered with a canvas. If more convenient they may be kept in a cool cellar or in a ditch or stream. If left too long in bales or sacks without air and light the leaves will fall and the vines may die.

Although vines will root at any time, it is preferable to plant in May or June so the vines may have some time to root before fall. Most of the older bogs have been set by hand. The land is first scratched each way with a rake-like marker. At each intersection a bunch of two or three pieces of vine is pressed into the ground with a dibble or planting tool and the hole closed firmly around the vines. Where this method is followed, the vines are carried in a basket and the planter works entirely in a kneeling position. A more popular method in the Maritimes is for the planters to work in pairs, one placing the vines and walking backward, the other walking forward with the planting tool. This tool is a blunt, narrow wooden spade, faced with thin sheet metal, and with a concave edge to grip the vines. The vines are thrust through the sand into the muck below and the hole is closed by the heel at

the next forward step. Seven to twelve inches apart is a common distance. The closer plantings cover the ground more quickly and are believed to come into fruiting earlier. When the supply of vines is plentiful, they are sometimes chopped into pieces two or three inches long, scattered thinly over the land, covered by an ordinary farm disk, and rolled to pack the sand around them.

Immediately after planting, if water is available, the ditches are filled and the water held for a couple of days. In cool rainy weather this may not be necessary but it may be desirable to flood once or twice during the summer if the season is dry.

Weed Control

Thorough drainage is the most important step in weed control. Poor drainage stimulates the growth of moss, sedges, rushes, loosestrife and other water-loving plants. Bogs are rarely if ever ditched too deeply, but on the other hand shallow ditches are far too prevalent.

If the water-table is near the surface the roots are shallow and during a dry period the plants may actually suffer from drought. Deep ditches encourage a deeper root system, which in turn supports a larger top growth. Vigorous vines not only produce larger yields of fruit but also make it much more difficult for weeds to become established.

Although no complete substitute for hand weeding has been found, selective weed killers are claiming a larger place in modern bog management. A few of the more important materials are discussed below.

Water-white Kerosene.—Stove oil or any colored petroleum product is likely to damage cranberry vines, but the clear transparent oil may be used in early spring with little injury. It is recommended for sedges, loose-

Figure 7.—Rake-like marker used in preparation for planting.

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Figure 8.—Planting gang in operation.

strife and many grasses at 400 to 600 gallons per acre. Individual clumps of rushes may be treated by punching a hole in the crown and filling with a cup or two of oil.

Varsol or Stoddard Solvent.—Commonly used as a cleaning material, this is a useful substitute for kerosene in control of grass. It is applied early in spring before new growth begins and is used at 300 to 400 gallons per acre.

Ferric Sulphate.—This is useful on horsetail, rushes and some grasses. It is applied at the rate of 15 to 20 pounds per square rod, on young plants.

Sodium Arsenite.—Sold under the trade name of Weedicide, this is highly poisonous to animals and destroys most living plants. It is used only for the banks of ditches and dykes. Apply as a spray, 15 pounds per hundred gallons of water.

Ammonium Sulphamate.—Known to the trade as Ammate, this material is non-poisonous but destructive to most plants, including the cranberry. It is used for ditch banks and dykes, and is coming into popularity as a substitute for turfing new bogs. It may be used as a spray, 75 pounds per 100 gallons of water, or applied by hand at 200 to 300 pounds per acre.

2,4-D.—All the forms of this new weed-killer are fatal to cranberries, but it may be used if the weeds are so thick that the cranberry vines are sheltered. Generally speaking, none of the narrow-leaved plants, such as grasses, sedges or rushes, are affected by 2,4-D.

Flooding

If the ground is frozen so that the plants cannot secure water, cranberry vines are often injured or killed by drying winds. In regions of heavy snowfall, the snow covering seems to be reasonably satisfactory, but open bogs are frequently swept free of snow and for this reason water is a safer and more dependable protection.

As soon as the sand becomes stiff enough to resist denting with the heel, the water is turned on and the bog is flooded just deeply enough to cover the vines. A shallow flood allows the plants to receive more light and there is less danger that cracks in the ice will tear the vines. When thaws occur, the outlet must be kept free so the water will not rise and lift the ice and with it the embedded vines.

It is customary to hold the winter flood in the Maritimes until around May 24 unless ample water is available for re-flooding. While early draining encourages the fruit-worm and false army-worm, late draining is favorable to the cutworm; thus bogs with a full water supply are sometimes drained early in April in alternate years.

Re-flooding may be necessary whenever there is danger of frost, but should be avoided at blossom time. If the bog is well graded it may be possible to raise the water just up to the bottom of the vines and the heat given off by the water will protect the plants even though temperatures are several degrees below the freezing point. The new growth, fruit buds and bloom are all easily injured by frost. Green fruit is also tender but as maturity approaches the danger from frost is lessened. There is an opinion among shippers that exposure of mature fruit to any appreciable frost shortens the storage life of cranberries. Flooding at this time interferes with picking and also softens the berries, so temperature forecasts should be studied carefully and the use of water kept to a minimum.

Immediately after picking, flooding for a week or ten days freshens the roots that have been loosened and also lifts much of the rubbish and fallen fruit. Flooding at this time is helpful in control of cranberry fruit-worm.

Sprinkler systems are now in use on many bogs where the water supply is inadequate for flooding. While somewhat costly to install, they are particularly effective in frost control, since the protection is available the moment the water is turned on, and picking can be resumed more quickly after the danger period has passed. Some growers believe the fruit is firmer and keeps better in storage if it is not immersed at any time.

Figure 9.—Setting cranberry cutting with dibble.

Re-sanding

Frequent applications of sand, from a quarter-inch to an inch, are a protection against mild frosts and many insects, and also aid in checking moss and weeds. Bogs with a limited water supply should be sanded every year or second year. If the vine growth is weak, sanding will stimulate development of new roots and uprights. Bogs with plenty of water and a fair growth of vines may be sanded every three or four years. The only bogs on which fresh sand is not needed are those with heavy vines and full supplies of water for insect and frost protection at all times.

Sanding on the ice during the winter, as mentioned earlier, needs the least labor, but is not recommended after the bog comes into production. Covering the ice with sand excludes light, partially starving the plants, and the crop usually suffers somewhat the next season. Laying planks for a track, and spreading direct from a wheelbarrow in the fall using a square-mouth shovel is the best. In the spring the vines are easily injured, particularly after growth begins.

Fertilizing

On most peat or muck bogs no attention need be paid to fertilizer. Sufficient plant food is usually present to produce a healthy cover of vines and regular crops of fruit. On hard-bottom bogs or those badly neglected, the use of nitrate of soda may stimulate growth. Stable manure is not satisfactory as it carries weed seeds; sulphate of ammonia is injurious; potash is said to be of little benefit.

The Agricultural Experiment Station, East Wareham, Mass., suggests 150 pounds of nitrate of soda and 300 pounds of superphosphate per acre, at the beginning of bloom. However, little is known of the nutrition of the cranberry, and grass, sedges and other weeds are often stimulated more than the cranberry vines. For this reason it may be wise to try the effect on a small plot before making a large outlay.

Pruning

Following the picking season, torn vines should be removed. In cases where the vines become extremely thick it may be desirable to prune lightly. A pruning rake, having curved blades in place of teeth, is used, but this operation is recommended only if the vines become so thick and matted that the yields of fruit are reduced. When using at least one style of mechanical picker, clipping at a uniform height is recommended. This encourages fine new uprights which later carry the berries at a convenient level for harvesting. This type of pruning may be done with a small mower attachment.

Picking and Caring for the Crop

The first picking date will depend on the varieties grown. When early and late varieties are both present the picking season is extended. In Cape Cod the work is usually begun the first of September and finished the middle of October. In Nova Scotia, Early Blacks are seldom ripe enough to gather before September 10, and the work is pushed rapidly to finish before severe frosts. The berries should be allowed to ripen on the vines as fully as possible, since well-colored fruit not only brings a higher price but is less easily bruised, keeps longer, gives higher yields and makes better sauce.

Until the vines are firmly established and covering the ground, hand picking is necessary. Special snap pickers have been made for this work, but these require a strong grip and a fair degree of skill. When the bog reaches maturity, scoops of varying width are used for picking. Several mechanical pickers, designed to lessen hand labor, have been developed and employed by growers with varying degrees of approval.

Pickers are kept in line by stretching strings to form lanes, thus avoiding crowding and skipping. Picking should be done only when the plants are dry. If flooding is necessary because of a frosty night, picking may be impossible the next day. Berries are picked into slatted boxes and carried or wheeled to the edge of the bog, from where they are hauled to the storage sheds or screenhouse. Bruising and subsequent decay seem inevitable with any mechanical cleaners, and for this reason the berries keep better if stored in these boxes until they can be graded, packed and marketed.

The screenhouse is a frost-proof building with a cool storage and a well-lighted, warm room for sorting. The berries are first run through a separator provided with a fan for removing the chaff and having several bounding boards which take out the rotten and light berries. From the separator the fruit passes over an endless belt, where green berries are removed by hand. The separator is preferably set up in a cool room from which the berries can be carried on an endless belt to the sorting room and thence to shipping boxes or packaging machines. To meet the demand for pre-packaged food, many berries are packed in 1-pound cellophane bags, or cartons having a cellophane window. These are sealed in a master container of strong cardboard. Recent expansion of the canning industry and increasing popularity of the canned product provides an outlet at prices often equal in net returns to those received for fresh fruit. Frozen cranberries can be held and processed over a long period.

Figure 10.—Cranberry pickers at work showing use of scoop.

Figure 11.—A new type mechanical picker.

Figure 12.—Cranberry pickers at work. Note strings put down to guide pickers.

Varieties

Until recently very few named varieties of cranberries were grown in Canada and many of the older bogs were planted by growers who selected varieties of their own. A few importations from Cape Cod were made many

years ago, and more recently Early Black and Howes have been introduced. These two varieties, from a large number selected by early Cape Cod growers, have done well in most places.

Howes has been regarded as a late or main season variety, ripening at about the same time as most of the native wild berries of the Maritimes. Early Black, about ten days earlier than Howes, is a smaller berry but the vines develop a large number of fine uprights which in turn carry a heavy yield. Beaver, a new variety recently introduced by the Experimental Farms Service, has been a week earlier than Early Black, with a larger, brighter colored berry, which has kept well in storage tests. As fall frosts are an ever present danger, early ripening is important in all regions of Eastern Canada.

Figure 13. Howes in August of the second season.

The new varieties, Beckwith, Stevens and Wilcox, have recently been released by the United States Department of Agriculture. These have not been grown commercially in Eastern Canada but have been introduced on the Pacific Coast. They are reported to be high yielding and mid- or late-season in ripening.

If more than one variety is set, it is desirable that each be on a separate section and under separate flood control, as the varieties may vary in bloom and picking dates and differ in their susceptibility to diseases and insect pests.

Pumping Outfits

When selecting equipment for flooding, an engine and pump should be secured of larger capacity than that which is estimated to do the job when working perfectly. A reserve of power and speed is always useful in an emergency, and is less costly than the loss that sometimes follows too light an installation. The pump should be large enough to flood the bog in 6 or 7 hours. It is well also to deal with a firm having experience in supplying pumping units for cranberry bogs.

If the lift is under 6 feet, the ordinary propeller pump is probably the cheapest and most efficient, but if the lift is greater, a rotary or impeller pump is suggested.

APPROXIMATE TIME TO FLOOD ONE ACRE—IN HOURS AND MINUTES

Depth in inches per acre	Gallons on each acre	Time required and flow per minute					
		100 gals. per m.	500 gals. per m.	1,000 gals. per m.	5,000 gals. per m.	10,000 gals. per m.	20,000 gals. per m.
1 in.....	27,154	4½ h.	54 m.	27 m.	5½ m.	2m. 40s.	1m. 20s.
2 "	54,309	9 h.	1¾ h.	55 m.	11 m.	5m. 30s.	2m. 45s.
3 "	81,463	13½ h.	2¾ h.	1¼ h.	16 m.	8 m.	4 m.
4 "	108,617	18 h.	3½ h.	1¾ h.	22 m.	11 m.	5½ m.
5 "	135,771	22½ h.	4½ h.	2¼ h.	28 m.	14 m.	7 m.
6 "	162,926	27 h.	5½ h.	2¾ h.	33 m.	16½ m.	8¼ m.
7 "	190,080	31½ h.	6½ h.	3¼ h.	38 m.	19 m.	9½ m.
8 "	217,234	36 h.	7½ h.	3¾ h.	44 m.	22 m.	11 m.
9 "	244,389	40½ h.	8 h.	4¼ h.	49 m.	25 m.	12½ m.
10 "	271,542	45 h.	9 h.	4¾ h.	54 m.	27 m.	13½ m.
11 "	298,697	49½ h.	10 h.	5½ h.	60 m.	30 m.	15 m.
12 "	325,851	54 h.	11 h.	5¾ h.	1h. 6m.	33 m.	16½ m.
18 "	488,777	81½ h.	16 h.	8 h.	1 h. 38m.	49 m.	24½ m.
24 "	651,703	108½ h.	22 h.	11 h.	2h. 10m.	1h. 5m.	32½ m.

The accompanying table is useful in estimating the amount of water needed for flooding and also the capacity of the pump required. It shows that 6 inches of water can be applied on one acre in 5½ hours by a pump throwing 500 gallons per minute. With a six-acre bog to flood it is readily seen that it will take a pump six times the capacity, or 3,000 gallons per minute, to do the job. Other calculations can be made similarly.

Figures 14 to 16 show an installation designed to lift water from a brook, through a flume, to a reservoir 16 feet or more above and a half-mile away.

Figure 14.—Enclosed impeller pump housed in building shown in Figure 15. It lifts water from a brook and pumps through the flume shown in Figure 15 to the reservoir shown in Figure 16.

Figure 15—Pump house and flume.

From this reservoir or compound, another pump lifts the water a similar distance to flood a 30-acre bog. In this way flooding is done quickly and cheaply.

Cost of Constructing a Bog

Complete cost figures are not available for older established bogs. However, careful time sheets have been kept for two small bog developments which the Experimental Farms Service shared, and these give a useful lead in this connection.

The first of these was at Port Mouton, N.S., and covered the preparation of a one-acre addition to a bog where the main reservoir, ditch and dams were already built. This was a black muck soil, heavily covered with laurel, leatherleaf and swamp grass. The hours of man-labor required for the one acre were as follows:

Ditching	54	hours
Turfing	977	"
Hauling and spreading sand	584	"
Cutting and planting vines	117	"
Total	1,732	hours.

Figure 16.—Reservoir into which water is pumped.

The second of these was at Cumberland Point, N.B., where the bog was on a stiff clay bottom, covered with heavy swamp grass. The turf was not removed but was cut and turned completely under. The figures are for three-fourths of an acre:

Clearing land	3	hours
Draining	40	"
Ditching	229	"
Levelling	59	"
Turfing	286	"
Sanding—Man	419	"
Sanding—Team	65	"
Total man hours	1,036	"
Total team hours	65	"

Neither of these sets of figures covers the entire cost of bog building. It will be noted that the initial value of the land is not included and no stumps of trees were present. The removal of large trees by bulldozer or dynamite can be an expensive operation.

When in full production, a few bogs have returned in gross sales for a single year an amount equal to their entire initial cost. This has only been achieved by close attention to every detail and it is not suggested that cranberry growing is an easy path to wealth for the careless or incompetent.

The permanence of the investment is indicated in the Bishop bog at Auburn, Nova Scotia. Recently equipped with an automatic sprinkler, and still yielding heavily after being in production over seventy years, this is believed to be the oldest commercial bog in Canada. Other bogs in the same area, equally as well located but lacking regular weeding, ditching, and sanding have reverted to a wilderness of swamp, shrubs, and scrub forest.

CRANBERRY DISEASES

by

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The cranberry is comparatively free from destructive diseases and it has been suggested that this is due to the fact that it is a native plant growing in its natural surroundings. The chief troubles are a virus disease known as false blossom, several fungus diseases of the vines, and certain storage rots of the harvested fruit. Other losses can occur through frosts and flooding. Two diseases to be discussed here have not been found in Canada, but they are present in the important cranberry-growing districts of the United States and undoubtedly will be found in Canada as the area planted to this crop increases and more attention is paid to it.

False Blossom

(Caused by a virus)

The most serious disease of cranberries in North America is false blossom, a virus disease that derives its name from the abnormal flowers. In the early stages of the disease, the flowers stand erect instead of drooping normally, and the petals have a tendency to be brighter colored than healthy ones. In advanced cases, the flowers do not develop properly and have stunted petals or none. The plants themselves take on the appearance of a witches' broom, as a result of the lateral branches and small leaves growing close to the stem. Diseased plants do not produce a marketable crop. The disease is most easily recognized when the plants are in blossom or during the latter part of August when the witches' brooms are most prominent.

False blossom is carried from bog to bog and from district to district in affected vines used for new plantings. In a bog and between neighboring bogs, it is spread only by the blunt-nosed leaf hopper.

The control of this disease requires careful attention on the part of the grower. When planting a new bog he must take great care to get vines from a disease-free bog. The need for healthy vines for planting cannot be stressed too strongly, for the disease spreads most rapidly in a newly planted bog and most slowly in an old, well-established bog. If the disease is established at a number of points in a bog it becomes necessary to control the blunt-nosed leaf hopper since this insect is the carrier responsible for the spread of the disease from plant to plant. Control of this insect is discussed in the section on insects.

All varieties of cranberries are not equally susceptible to this disease. Howes is quite susceptible and Early Black is one of the most resistant available.

Fungus Diseases of the Vines

A number of fungus diseases cause damage in the cranberry bogs, but none has proved destructive over large areas. Such diseases are usually limited to one bog, or to a more or less definite area in a bog, and in such a manner that it is obvious that the surroundings must have determined the severity of the attack.

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Tip Blight and Hard Rot

(Caused by *Sclerotinia oxycocci* Wor.)

Although tip blight kills the young points just before blossom time and is therefore considered a vine disease, it is more important as a fruit rot. It starts as a typical blight, killing the tips of the vines. The tips turn brown and become misshapen as a result of the growth of the fungus at certain points within the bark. These areas of fungus growth develop a grayish powdery mass of spores, which serve to infect the forming berries at blossoming time. The infected berries do not show outward signs of the disease until they start to ripen in the fall. They do not color naturally but become yellowish and remain hard. If an unripe infected berry is cut open, a white cottony fungus growth will be found around the seeds. During the fall, they shrivel, become mummified, and drop to the ground, where they overwinter. In the spring, they produce the fruiting bodies of the fungus from which infection of the young tips occurs during wet weather.

This disease is most important in Wisconsin and on the Pacific coast, and has been found in New Brunswick. No control measures have been recommended.

Red Leaf Spot and Rose Bloom

(Caused by *Exobasidium vaccinii* (Fckl.) Wor.)
(*Exobasidium oxycocci* Rostr.)

Red leaf spot and rose bloom have been considered as two diseases but the causal organisms appear to be identical. They are conspicuous diseases that immediately attract attention because of the bright colors induced in the diseased parts of the affected plants.

In plants affected with red leaf spot, the bright red color of the spot is conspicuous on the upper surface of the leaves. The color is duller on the lower surface and the spots are covered with a bloom of spores. The red spots may be found on the fruit.

In plants affected with rose bloom, dormant buds along the stem are stimulated so that they develop as shoots early in the spring. The foliage on these shoots is bunched, twisted, rose colored and its resemblance to a flower accounts for the descriptive name applied to the disease.

Red leaf spot and rose bloom are of most economic importance on the Pacific coast where the recommended control is to flood the bog for from 36 to 40 hours just before the spores are discharged.

Red Gall

(Caused by *Synchytrium vaccinii* Thomas)

Red gall is recognized by the small shot-like red galls on the young buds, leaves and shoots. It is very erratic in its behavior and is not usually of great economic importance, although infected shoots do not bear fruit. Its irregularity in attacking the plants is due to the fact that the fungus depends on water for its distribution.

This disease occurs along the Atlantic seaboard and has been found in Nova Scotia, where it has been severe in one bog. Control has been secured by early removal of water in the spring.

Fairy Rings

(Caused by *Psilocybe agrariella* Atk. var. *vaccinii* Charles)

Fairy rings in cranberry bogs are similar in origin to fairy rings in lawns and pastures and, like them, are caused by a species of mushroom. In a bog, the vines are killed, apparently by the fungus smothering the roots as it grows in a widening circle from some point. As the circle extends, the center becomes filled in with new vines so that the trouble is most apparent under poor growing conditions or in dry seasons. This disease is troublesome in Massachusetts and New Jersey, but has not been recognized in Canada. It can be controlled by ditching around the infected ring.

Black Spot

(Caused by *Mycosphaerella nigro-maculans* Shear)

Black spot is a disease that has been reported from all the American cranberry districts but is of economic importance only in the Pacific coastal region. It becomes troublesome in seasons of excessive moisture. The leaves are infected first, and the infection spreads until it reaches the stem, where it forms a black canker that frequently kills the plant. This disease has been effectively controlled by spraying with bordeaux mixture.

Leaf Diseases

(Caused by *Naevia oxycocci* Dearness)

A leaf disease, caused by *Naevia oxycocci* has been reported as occurring on certain dry bogs in New Brunswick. The vines weaken and die. This fungus is reported as causing a witches' broom in the United States. To date control measures have not been necessary.

(Caused by *Gibbera compacta* (Pk.) Shear)

Another leaf disease that occurs wherever cranberries grow is caused by *Gibbera compacta.* It forms black spots on the underside of the leaves. It is conspicuous but only slightly harmful. Special control measures have not been attempted.

Storage Rots

Storage rots are responsible for an annual estimated loss of 25 per cent of the cranberry crop of the United States, and it appears that the situation is similar in Canada. Extensive studies have shown that fungi are responsible for most of the damage. In the affected berries where no organism can be found, the rot has been named sterile breakdown.

The different rots of cranberries are so similar in appearance that the causal organisms can only be identified by making isolations from them in the laboratory. The fungi responsible for the rots are widely distributed wherever cranberries grow and their importance locally is determined largely by the mean temperature during the growing season. Thus under the higher summer temperatures in New Jersey the fruit may rot in the bogs before harvesting while in Nova Scotia rotting berries are rarely found until after the fruit is in storage.

Most storage losses in Nova Scotia are due to end rot, a disease caused by *Godronia cassandrae* Peck (*Fusicoccum putrefaciens,* Shear.) Sterile breakdown is the next most important cause of loss in storage. These two rots account for over half of the storage losses in Nova Scotia. Other losses are

attributable to a number of organisms common to all cranberry growing areas of North America. These are *Sporonema oxycocci* Shear, *Pestalozzia guepini* var. *vaccinii* Shear, both of which cause storage rots; *Ceuthospora lunata* Shear, the cause of black rot and *Diaporthe vaccinii* Shear, causing fruit rot.

Special mention should be made of two fungi that are very common on sound cranberries in Nova Scotia. They are *Guignardia vaccinii* Shear, (early rot) and *Acanthorhyncus vaccinii* Shear (blotch rot). Under New Jersey conditions these two organisms cause severe losses through field and storage rots. In Nova Scotia these organisms live only in the skin and have never been found associated with a rot.

Various rot-producing fungi have been found in the dried remains of the calyx of many sound berries. The infection takes place in the bog, during the summer and the rot organisms are able to lie dormant awaiting favorable conditions for growth. It is evident that the presence of these fungi in the calyx explains the progressive rotting of the fruit after harvest and indicates the necessity for the maintenance of proper storage conditions.

The control of storage rots depends on a number of factors. Methods of control vary according to locality and condition of the fruit. The firmness of the berries in some years ensures good keeping qualities without much trouble while in other years the berries are so tender that only by careful handling and good storage conditions can the fruit reach the market in an attractive condition. Every effort must be taken to prevent bruising during harvesting, cleaning and packing. The berries should be dry when stored, or if they have been harvested wet, should be dried quickly. The fruit should be stored at cool temperatures with good ventilation.

Spraying will reduce storage rots but a régular seasonal program has not proved economical in the more northerly cranberry growing areas. However, spraying with fungicides may be necessary for protection from a particular disease. The organic spray materials ferbam, ziram and maneb have proved satisfactory for use on cranberries and are sold under different trade names. Each should be used according to the manufacturer's instructions.

The standard bordeaux spray mixture used for years is still effective and the materials are easily available. It is made according to the following formula:

10 pounds of copper sulphate (bluestone)
10 pounds of hydrated lime or fresh stone lime
100 gallons of water
1¼ pounds of commercial fish oil soap

Dissolve the soap in water and add to the bordeaux. Spraying should be at two-week intervals, starting at blossoming time and ending not later than the middle of August.

A grower who would like to have further information on his own district, or to have disease specimens identified, should communicate with the Botany and Plant Pathology Division, Canada Department of Agriculture, Ottawa, or the nearest Plant Pathology Laboratory.

INSECTS AFFECTING THE CRANBERRY

by

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Cranberry Fruitworm

The cranberry fruitworm, *Mineola vaccinii* (Riley), is the most serious insect pest with which growers of the low bush or bog cranberry in the Maritime Provinces have to contend and the ravages of this pest cause losses each year amounting to thousands of dollars. The insect is native to this country and is often found infesting cultivated and natural or wild bogs. This insect has also been found at times damaging the low bush blueberry.

The cranberry fruitworm spends the winter as a full grown larva in a cocoon either on the surface of the soil or slightly below. The cocoon may be formed of small grains of sand or particles of peat or trash, held together by strands of silk. In the spring the larva goes into the pupal stage to emerge as a moth when the cranberry is in the late bloom stage. The female moth usually lays her eggs within the calyx cup under the lobes but they may be laid on any part of the berry. The newly hatched larva enters the berry near the stem end and closes the entrance with a fine silken web. After feeding for some time on the pulp the larva leaves the berry to enter a second one in the same manner. When, as usually happens, the larva enters a third, fourth or fifth berry, it does so through the side. Early in the fall it becomes fully grown and constructs the cocoon in which it hibernates.

Control—Infestations of this insect may be reduced to a minimum by the use of insecticidal dusts and sprays or by flooding the bog, if such facilities are available. Cranberries growing wild on lowlands bordering rivers which are normally flooded each spring by freshet water do not usually support heavy infestation of this insect but on higher ground the infestation usually increases. A large measure of control occurs on cultivated bogs provided the water is held on the bog until near the end of May. If the infestation persists and flood water is available, the bog should be flooded again immediately after harvest and the water held for seventeen days.

Where flooding is not possible the bog may be treated with insecticides, in either dust or spray form the preference depending on the site and nature of the bog, the water supply, and the machinery available. Two applications of the insecticide are necessary, the first being made when two-thirds of the blooms have dropped and the second application ten days later.

Heavy spraying machinery cannot be used on cranberry bogs without causing serious damage to vines. However, such spraying machinery can be set up on the edge of the bog and applications made by the use of a long hose. Hand-pumped or small power sprayers may be used to advantage. The spray rod should consist of a boom of at least three nozzles capable of delivering fine spray and should be offset at an angle of approximately 135 degrees with the handle of the rod. The hose should be held off the vines by an assistant during

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spraying operations. The amount of spray used per acre should not be less than 400 gallons, delivered at a minimum pressure of 250 pounds per square inch.

Nicotine sulphate at the rate of 1⅓ quarts in 100 gallons of water has proved effective against this insect and when combined with bordeaux mixture (10-10-100) the control has been even more satisfactory. The nicotine sulphate should be added to the completed bordeaux mixture. DDT in the emulsion form is more effective than nicotine sulphate but serious injury to vines has resulted from it when used at a strength greater than ½ pound of actual DDT per 100 gallons. The wettable powder form of DDT should be effective when used at the rate of 2 pounds of actual DDT to 100 gallons of water or bordeaux mixture and should not injure the vines.

Control of this pest by applications of insecticidal dusts is less troublesome than spraying. The applications are much less time consuming and the outlay for dusting machinery need not be so great as for spraying equipment. In large commercial cranberry growing areas, small dusters powered by gasoline engines are used. Being light and equipped with two rubber-tired wheels of the bicycle or motorcycle type they may be pulled across the bog by two operators or may be self-propelled. A hand-turned duster, of the old model Niagara type, mounted on a platform and geared to one of the two bicycle wheels on which it is mounted has proved effective in the control of this insect. This traction-driven duster has three dust nozzles and carries a trailing canvas or apron which is indispensable in dusting this crop. The hand-turned duster, when used as such, is not entirely satisfactory. In order to get reasonably satisfactory results, weather conditions must be ideal and with only two dust nozzles a thorough and even coverage may be applied only when extreme care is taken. On areas missed or where the dust has not thoroughly penetrated, injured berries are likely to be found. It is preferable to make all dust applications during the late afternoon rather than in the early morning when vines are wet with dew.

A mixture of 70 parts finely ground dusting gypsum, talc or pyrophyllite combined with 30 parts of synthetic cryolite has given good control of this pest. Freshly mixed dusts have been found most satisfactory. Material left over from a previous season is difficult to apply, particularly if the carrier used is gypsum, and especially if applied with a hand-turned duster. Not less than 50 pounds per acre should be used. A 5 per cent DDT dust have been found to be a fairly satisfactory dust treatment, applications of which should be made at approximately 40 pounds per acre.

Fireworms

There are a number of species of fireworms which occasionally cause damage to cranberry bogs. The black-headed fireworm, *Rhopobota naevana* (Hbn.), is the most serious in the Maritime Provinces. In Nova Scotia this insect frequently causes very serious damage to cultivated bogs and in New Brunswick it has occasionally injured quite large areas of lowland bogs. The young caterpillars feed on the terminal leaves, tying them more or less together, in the early stages, and skeletonizing them, with the result that heavily infested areas become brown suggesting scorching by fire. There are two generations a year, the caterpillars of the first generation, which usually cause the most serious injury, appearing in May from eggs laid by the over-wintering moths. The adults of the second generation appear in late June and early July and caterpillars of this generation tie together the tender uprights and feed upon the leaves and berries. Other species of fire-

worms attacking the cranberry are the yellow-headed fireworms, *Acleris minuta* (Rob.), which prefers highland bogs and is seldom seen on lowland bogs and the striped fireworm, *Aroga trialbamacullella* (Chamb.), which may become a serious pest of highland bogs only.

Control—Holding the winter flood well into May or, with bogs drawn about May 10, flooding again for 48 hours about May 28, if the worms are about one-half inch long, results in an excellent control of the black-headed fireworm. Where flood water is not available fireworms may be controlled by spraying with arsenate of lead at the rate of 6 pounds per 100 gallons of water. Pyrethrum dust (0.9% pyrethrins) or 5 per cent DDT dust applied at the rate of 50 pounds per acre have proved effective. The addition of 1¾ pints of nicotine sulphate to the aforementioned mixture improves its effectiveness.

Chain-spotted Geometer

The measuring worm, *Cingilia catenaria* (Drury), reaches outbreak numbers in some years and has at such times caused very serious damage to cranberry bogs in the Maritime Provinces. During such outbreaks the larvae behave similarly to armyworms, devouring the foliage from practically all species of plants in their paths of travel. They have been observed stripping the foliage from blueberry, wild spiraea, birch, huckleberry, sweet fern, and other plants as well as cranberry. The overwintering eggs hatch in the spring, the larvae become fully grown in mid-July and then enter the pupal stage. The moths emerge in late August and early September to lay their overwintering eggs.

Control—Treatments should be applied as soon as the insects are discovered. Because of their yellow and black spotted colors the "worms" are not readily detected and growers should be on the lookout for any injuries that might be caused by them. Control may be obtained by spraying with arsenate of lead at the rate of 5 pounds per 100 gallons or dusting with a mixture composed of 70 parts gypsum or talc and 30 parts of synthetic cryolite.

Preliminary trials suggest that pyrethrum dusts are quite effective. It also appears likely that the insects may be controlled by the use of a 3 per cent DDT dust.

Blunt-nosed Cranberry Leafhopper

Although species of leafhoppers frequently cause extensive damage to various crops by puncturing plant tissue and sucking out the plant juices, cranberry growers are mostly concerned about the blunt-nosed cranberry leafhopper, *Ophiola vaccinii* (Van D), as this insect is responsible, through its feeding activities, for the spread of the virus disease known as 'false blossom'. This disease has been found in all parts of Nova Scotia except Cape Breton Island but has not yet been reported in New Brunswick. Where it does not exist and where the leafhoppers are not prevalent enough to cause general damage there is little necessity of controlling this insect. The overwintering eggs of the leafhopper hatch early in the spring and the nymphs reach the adult stage in early summer. These leafhoppers may be controlled by applying pyrethrum dust (0.9% pyrethrins) at the rate of 50 pounds per acre when the vines are one-tenth in bloom. A spray of pyrethrum soap, 6 pounds per 100 gallons of water, at the rate of 400 gallons per acre is also effective. This soap should not be used when the vines are in full bloom or when the berries are small as it may injure the berries.

Spittle Bugs

The cranberry spittle bug, *Clastoptera vittata* Ball, is another bog pest which in some years becomes numerous and causes considerable injury. The presence of this pest is easily detected by the froth or spittle on the vines. Within each ball of spittle is a single insect which obtains food by piercing the vine and extracting the plant juices. When numerous, these bugs may reduce the vigor of the vines and the size of the crop.

There is only one generation of this insect in a season. The winter is passed in the egg stage, the egg being inserted into the bark of the vine. The eggs hatch in early June, and the spittle is found soon after. The adults which emerge in July are easily flushed up from the vines when startled by a person passing over the bog.

Control—A spray of 1⅓ quarts of nicotine sulphate in 100 gallons of water thoroughly applied at the rate of 400 gallons to the acre will give excellent control of this pest. Dusting with pyrethrum when the spittle becomes abundant, usually in late June, is also effective.

Other Insects

There are a number of other species of insects which may cause damage to cranberry bogs among which are the blossomworms, tipworms, cutworms, root grubs, cranberry girdler, etc. Satisfactory methods of combating these pests have been found which often include the use of insecticides and of quick-flooding facilities. Insect life in the cranberry bog should be carefully watched by the growers in commercially producing areas and estimations of insect populations arrived at by making regular use of the sweeping net. The net is similar in principle to the butterfly net and the operator sweeps it across the tops of vines in front of him as he walks across the bog. The insects are dislodged from the vines and fall into the net. In this way the particular pests and their prevalence may be determined, the stage or period of their development noted, and the treatment for control accurately timed.

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